

# CO2 Sounder Lidar for Earth Science Missions

Completed Technology Project (2014 - 2018)



## Project Introduction

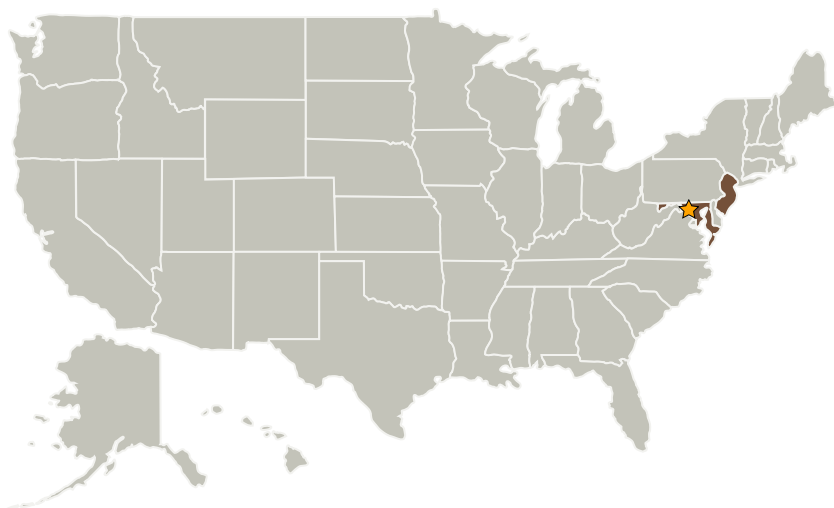
We have been developing the CO2 Sounder lidar to provide active (laser-based) column measurements of atmospheric CO2 from space. The tasks are to conduct OSSE experiments to clarify the science traceability matrix, support laser development to increase the laser power and increase the TRL, improving the receiver design and analysis and retrieval approaches, and to analyze lidar measurements of CO2 made from aircraft.

## Anticipated Benefits

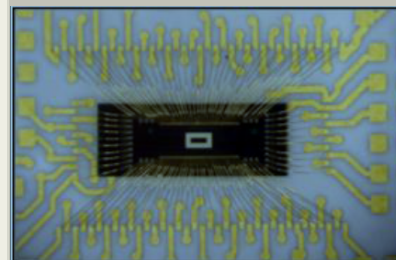
This project will benefit Earth Science Missions like NASA's planned ASCENDS Mission.

The technology will also benefit future orbital missions to measure the properties of the atmosphere using lidar.

## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Goddard Space Flight Center (GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland



Close up of the HgCdTe detector

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Co-Funding Partners	Type	Location
OFS Laboratories	Industry	Somerset, New York

Primary U.S. Work Locations	
Maryland	New Jersey

## Project Transitions

 **October 2014:** Project Start

## Organizational Responsibility

### Responsible Mission Directorate:

Mission Support Directorate (MSD)

### Lead Center / Facility:

Goddard Space Flight Center (GSFC)

### Responsible Program:

Center Independent Research & Development: GSFC IRAD

## Project Management

### Program Manager:

Peter M Hughes

### Project Managers:

Matthew J McGill  
William E Cutlip

### Principal Investigator:

James B Abshire

### Co-Investigators:

Jeffrey R Chen  
Stephan R Kawa  
Haris Riris  
Mark A Stephen  
Xiaoli Sun

## CO2 Sounder Lidar for Earth Science Missions

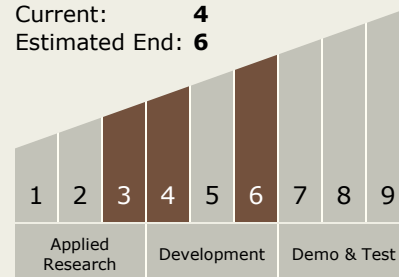
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**September 2018:** Closed out

**Closeout Summary:** The objectives of this work are to increase the scientific justification and technical readiness of our CO2 Sounder lidar space demonstration. The tasks include: Completing the environmental testing of the space laser precursor - This task is a continuation of a jointly supported by ESTO via an ATI award. The task in FY18 will complete the development of an engineering model of the *entire laser transmitter* and take it through environmental testing to TRL 6; Developing and demonstrating a new-generation airborne CO2 lidar. The present airborne CO2 Sounder lidar works quite well, but is large, fragile and is limited in laser power. Using the new laser developed will greatly reduce the size and complexity of the lidar, make it much more rugged, and will increase its laser pulse energy. This will improve the measurement precision by more than three times, and make the lidar's use practical on less-expensive higher-altitude aircraft, as well as smaller ones. The flexibility, higher performance, ruggedness, and smaller size will make it very attractive for future carbon-related airborne science campaigns, and as an airborne simulator. The overall objective of this work is to increase the science and technology readiness of the CO2 sounder. We are monitoring the evolving possibilities for these and can adapt the studies for them. The laser development will also produce a laser which will have x3 better performance. The purpose of the Goddard Space Flight Center's Internal Research and Development (IRAD) program is to support new technology development and to address scientific challenges. Each year, Principal Investigators (PIs) submit IRAD proposals and compete for funding for their development projects. Goddard's IRAD program supports eight Lines of Business: Astrophysics; Communications and Navigation; Cross-Cutting Technology and Capabilities; Earth Science; Heliophysics; Planetary Science; Science Small Satellites Technology; and Suborbital Platforms and Range Services. Task progress is evaluated twice a year at the Mid-term IRAD review and the end of the year. When the funding period has ended, the PIs compete again for IRAD funding or seek new sources of development and research funding or agree to external partnerships and collaborations. In some cases, when the development work has reached the appropriate Technology Readiness Level (TRL) level, the product is integrated into an actual NASA mission or used to support other government agencies. The technology may also be licensed out to the industry. The completion of a project does not necessarily indicate that the development work has stopped. The work could potentially continue in the future as a follow-on IRAD; or used in collaboration or partnership with Academia, Industry and other Government Agencies. If you are interested in partnering with NASA, see the TechPort Partnerships documentation available on the TechPort Help tab. <http://techport.nasa.gov/help>

## Technology Maturity (TRL)

Start: **3**  
 Current: **4**  
 Estimated End: **6**



## Technology Areas

### Primary:

- TX08 Sensors and Instruments
  - └ TX08.1 Remote Sensing Instruments/Sensors
  - └ TX08.1.5 Lasers

## Target Destinations

Earth, Mars

## Supported Mission

### Type

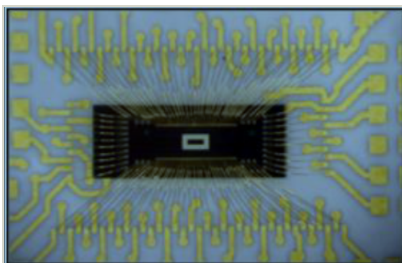
Planned Mission (Pull)

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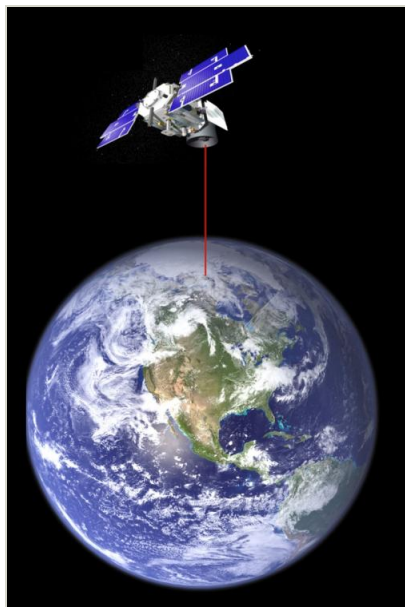


### Images



#### Close up of the HgCdTe detector

Close up of the HgCdTe detector  
(<https://techport.nasa.gov/image/36628>)



#### Concept for a space-based Co2 Sounder Lidar

Concept for a space-based Co2 Sounder Lidar  
(<https://techport.nasa.gov/image/36629>)

### Links

2014 Paper on 2011 airborne demonstration measurements in journal: Remote Sensing  
(<http://ssed.gsfc.nasa.gov/co2sounder/pdf/Co2RemSensingAbshireEtAl12-30-13.pdf>)

2015 Paper on HgCdTe APD detector  
(<https://ssed.gsfc.nasa.gov/co2sounder/pdf/DrsHgCdTeApdSullivanJEM5-15.pdf>)

2015 Paper on using the cloud slicing technique using Co2 lidar measurements  
(<https://ssed.gsfc.nasa.gov/co2sounder/pdf/Co2CloudSlicingRamanathanGRL3-27-15.pdf>)

Project overview presented at 2015 ESTO ESTF conference  
(<http://ssed.gsfc.nasa.gov/co2sounder/pdf/CO2SounderEstfAbshire62415.pdf>)

#### Project Website:

<http://sciences.gsfc.nasa.gov/sed/>